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Lake Chad: Fluctuating Water Level and Its Implications for People's Livelihood in the Area

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ABSTRACT: This study assessed the fluctuating water level of Lake Chad and its consequences on the livelihood of people that depend on it. In terms of depth, Lake Chad is very shallow which makes it vulnerable to climate change and human activities. The study opined that continuous reduction in the volume of water of the lake will lead to negative effects such as forceful migration, resource-induced conflict, loss of biodiversity etc. Insurgency spear-headed by Nigeria based terrorist organization, "Boko Haram", has killed many people including farmers and fishermen in the riparian countries of Nigeria, Niger, Chad and Cameroun and this has led to a decline in agricultural activities around the Lake Chad area making many to depend on food aid for their survival. The insurrectional activity of the terrorist group around the Lake Chad area also makes trade between communities extremely difficult as they are known to have attacked and killed people inside market. It is recommended that measures such as livelihood diversification through technology, creation of protected area, improved agricultural practices etc. should be adopted to reduce pressure on the lake and its resources.

Keywords: Rainfall, Livelihood, Lake Chad, Insurgency, Water level

INTRODUCTION

Lake Chad is a trans-boundary natural resource that supports both human and animal existence especially in the riparian countries of Nigeria, Niger, Chad and Cameroun. Chad has the biggest share of Lake Chad, followed by Nigeria, then Niger and Cameroon. Lake Chad is an essential source of water for human, livestock and also a good hunting ground for fishers who make brisk business from their catches. The Lake is mainly supplied by the Chari River (about 85% of total inputs), rain (between 7 and 14%) and other tributaries, including El Beid and Komadugu, Yobe (2 and 1.5% respectively) (LCBC, 2015). Despite the lake's large drainage basin, almost no water flows in from the dry north (UNEP, 2008). Because of its shallow depth, the lake is vulnerable to human activities and climate change. Lake Chad is a lake that experiences variations at different time scales and its level, surface, and landscape vary constantly according to months, seasons, years, decades, centuries, or longer sequences of geological time. The volume of water that flows in from the Chari River into Lake Chad primarily determines its size. It was found that, when the rainfall in the basin varies by 10%, the Chari's discharge varies by approximately 30% and as a result, Lake Chad is an amplifier of rainfall variations, hence its fragility (LCBC, 2015).

According to LCBC (2015), Lake Chad can be categorized into four groups viz; Large Lake Chad, Medium Lake Chad, Small Lake Chad and Dry Small Lake Chad. The large Lake formed an open water surface of about 24,000 km^2, surrounded by an undeveloped dune archipelago and occurred only for short periods during the 20th century, with the most recent occurrence in the early 1950s. After 1953 and until the early 1970s, a little less humid period, the 'Medium Lake Chad' presented throughout the year a single water body, measuring between 15,000 and 22,000 km^2 at an altitude of 280-282m, with two large basins, north and south, separated by the Great Barrier as shown in Figure 1 which consists of sand and vegetation and prevents water exchange between the two basins when the water level is too low. As of 1973, the lake as a whole was more a swamp and was made up of several water bodies which made it to be described as being small. This small stage of Lake Chad is particularly observed when contributions from the Chari River are below 35 km^3/year and permanent or seasonal swamps cover thus between 2,000 and 14,000 km^2 of the overall lake surface. The dry small

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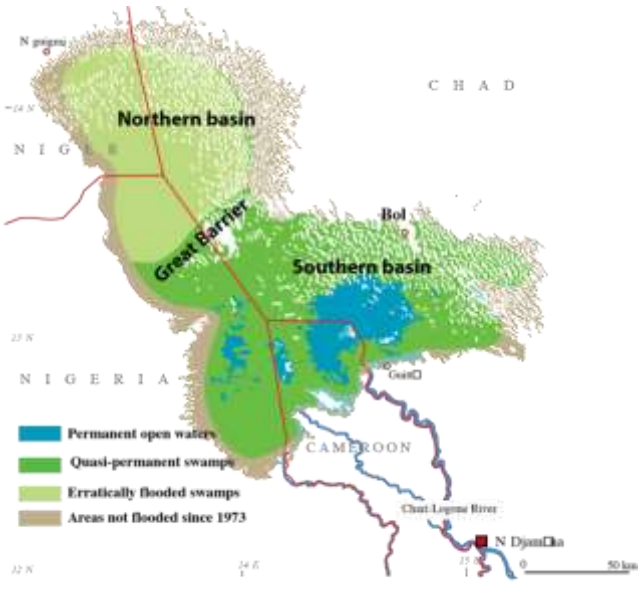
Lake Chad is observed when the annual inflow from the Chari River is below 15 km^3/year. The water level of Lake Chad has been fluctuating primarily because of rainfall variation. The northern portion of the lake is particularly sensitive and has completely dried up several times since 1975 (Lemoalle et al., 2012). A significant decrease in direct lake rainfall since the 1960s has largely been responsible for the fluctuating water level of Lake Chad and a severe drought in 1973. That had major effects on the area with the Sahel moving approximately 100 km south. As a result the lake water receded for more than 150 km from its northern and eastern shores, and by more than 80km from its western shoreline (Obaida et al., 2005). The effects of persistent reduction in water level occasioned by decrease in annual rainfall amount will not augur well for agricultural activities such as farming, fishing, and cattle rearing. Continuous reduction in the water level of the lake also portends an ominous sign for flora and fauna around the area and the interaction between them. Important species of plants and trees can disappear as a result of insufficient water to support their existence. And if care is not taken, sand dunes can take over lush area and the wild life community will also not be spared. The value of Lake Chad resides in the ecosystem services it provides. These are particularly precious in a Sahelo-Saharan regional environment characterized by aridity and the erratic availability of water resources. The impact of drought and reduced lake area has already been profound for people living close to the lake and it extends to a lesser extent to the over 35 million people who live in the larger Chad Basin (UNEP, 2004). As the lake recedes, farmers, herdsmen and others that their livelihoods depend either directly or indirectly on the lake will have no choice or alternative but to migrate to where their survival can be guaranteed leading to a resource-induced conflict between them and their host communities.

The four countries that share Lake Chad are plagued by some factors and these factors include illiteracy, high population growth rate, relatively high poverty rate and insurgency that has been spearheaded by Nigeria based terrorist group, Boko Haram. Since 2013-2014, Lake Chad and its regional environment have been affected by a crisis created by Boko Haram. This has deeply affected the regional system due to fighting, murders, and suicide attacks, displacement of hundreds of thousands of people within Nigeria or seeking refuge in or around the Lake Chad area of Niger, Cameroon, and Chad. The insurgency has driven a lot of fishers and farmers around the lake from their livelihood activities. The implication of this is a reduction in fish catches and farm produce. This paper provides a comprehensive review as persistent variation in the water level of Lake Chad poses a serious threat to agricultural activities and political stability of the four countries that share the lake. The more the water level of the lake continues to decrease or dry up, the more the future becomes uncertain for the population of people that their livelihoods depend on the lake and its resources especially in the face of rapid population growth, illiteracy, poverty and little or no job prospects. The population of the four countries that share the Lake will continue to increase which means water withdrawal for different uses will increase and that is why every good approach must be adopted to save the lake. According to Salkida (2012), the impact of the receding lake is causing tensions among communities around the lake and there are repeated conflicts among nationals of different countries over control of the remaining water. Cameroonians and Nigerians in Darak village, for example, constantly fight over the water as Nigerians in the village claim to be the first settlers while Cameroonians invoke nationalistic sentiments, since the village is within Cameroonian territory.



Source: Magrin, Lemoalle, Pourtier, 2015. *Atlas du lac Tchad.*

Figure 1: Average Situation of Lake Chad in its "small state," from 2010-2015

Source: LCBC, 2015

FOOD PRODUCTION IN LAKE CHAD AREA

The Lake Chad area is known for fishing, livestock rearing and farming. In 2010, it was estimated that Lake Chad annually produced 50,000 to 100,000 tons of fish (of which between half to two thirds were marketed), 600,000 to 900,000 tons of corn (270,000 to 540,000 tons marketed), plus various other farming products (cowpea on south banks, pepper in Komadugu, Yobe, diverse vegetables on south and south-east banks), most of them being marketed. Figure 2 shows agricultural products flow from countries around Lake Chad. These agricultural products are often marketed in regional metropolitan centres, Maiduguri, a redistribution hub towards other centres of Nigeria as well as N'Djamena. The products are also sold in the Sahelian hinterlands of Lake Chad, which experience structural cereal shortages (Kanem in Chad, Serbewel in Cameroon, Manga and Kadzell in Niger, Borno in Nigeria) (LCBC, 2015). The banks and islands of Lake Chad contained in 2014 a population of nearly 2 million people; this region was a food exporting hub, playing a key role for food security of a hinterland with nearly 13 million inhabitants and two metropolitan centres, N'Djamena, the capital of Chad, and Maiduguri, the capital of the State of Borno in Nigeria.

Insecurity being spear-headed by Nigeria based terrorist group, Boko Haram, is impacting negatively on food production in communities around Lake Chad. The area known for crop production, animal rearing and fishing has almost become a shadow of its former self as a result of killings, maiming, looting and arson attacks being perpetrated by Boko Haram terrorist group. Farmers and fishermen have been caught up in the web of Boko Haram insurgency, some are dead and those who managed to escape the onslaught have fled the area for their own safety. Because of the menace of Boko Haram, farming activities have been disrupted and livelihoods have been severely impacted upon making farmers and their families to live at the mercy of donor agencies and good spirited individuals. In Chad, the 2015/16 cereal production was estimated to be 11 percent lower than the previous year while in Cameroon and North East Nigeria, cash and staple food crops production was well below average, mostly due to low levels of precipitation and insecurity, preventing farmers from accessing their fields (FAO, 2016). Staple food prices have increased substantially in affected areas in Nigeria and Niger due to insecurity and increased transport costs and rises of up to 50-100 percent have been reported in some areas of Nigeria and the nutritional status of populations in these areas is of major concern, with global malnutrition prevalence rates ranging from 10 to 15 percent according to surveys (FAO, 2016).

FIGURE 2: LAKE CHAD'S CONTRIBUTION TO FOOD SECURITY IN THE REGION

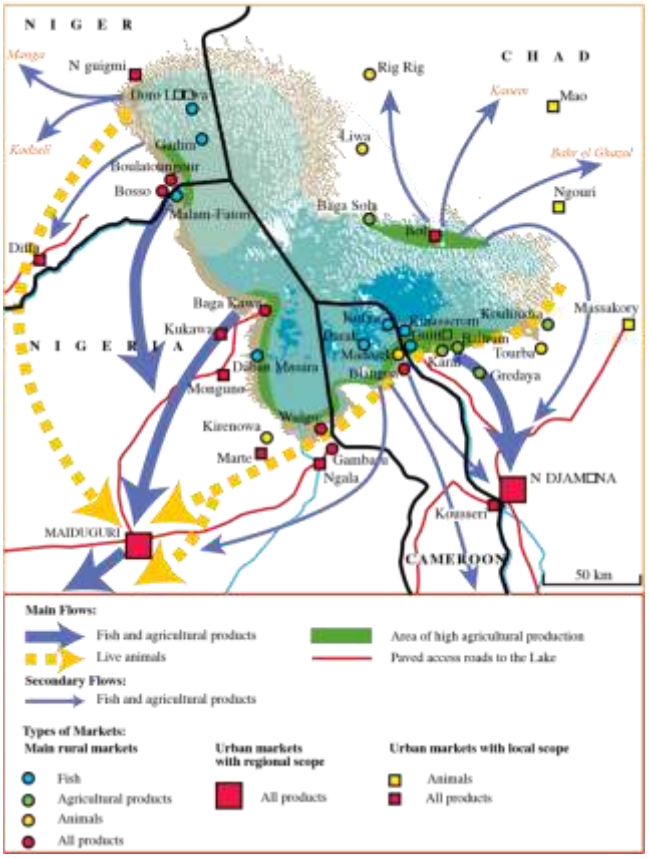


Figure 2: Flow of Agricultural Products from Countries Around Lake Chad

Source: Magrin et al., 2015

WATER, TRADE AND INSURGENCY

Maiduguri in Borno State, Nigeria, the birthplace of Boko Haram, used to be a vital trading post for fishermen, farmers, and traders who crossed the border from Chad to carry produce to the market in Maiduguri and with lower water levels and routes cut off due to insecurity caused by Boko Haram, boats are unable to reach Maiduguri, leaving thousands without their major market to trade. Since February 2015, the smoked fish market has been significantly affected in the Diffa region of Niger by the Boko Haram conflict and military operations to counter them, largely affecting freedom of movement and access to the

fishing areas (primarily the shores of Lake Chad but also some areas of the Koumadougou River) where military presence and controls have become stronger (Oxfam, 2017). On average, fishermen who were making $1,515 a year before the crisis are now making $420 a year, which represents a 72 percent drop in their yearly revenue. With this development, household income in the Diffa region will be severely hampered. This will impact negatively on the ability of households to feed their family members and to send their children to school. Also, the economy of the Lake Chad area and the national economy will also take a nosedive. Fishing in and around the Lake Chad is now a dangerous venture because fishermen can come under attacks any day and at any time from Boko Haram members and in the process, lives can be lost. The fear of Boko Haram is making fishermen to abandon their fishing business and to flee for their lives and this is contributing to unemployment in area where there is high level of joblessness. Unemployment exposes people to a lot of vices especially with the report that Boko Haram is using money as an inducement to recruit vulnerable people especially jobless youths into their deadly sect. The insurgency is putting pressure on households particularly fishing households to engage in unusual coping strategies. Twenty percent of the fishing households interviewed by Oxfam (2017) reported resorting to marrying their daughters earlier than they wanted to reduce pressure on resources. Because of the state of emergency declared by the government of Niger for the entire Diffa region on February 11, 2015 which led to the government implementing some measures which include the ban on fishing and selling of fish, fishermen mostly fish at night to avoid the military. The ban was put in place to cripple Boko Haram source of food supplies and also to prevent them from accessing money for their operations as the deadly sect cannot operate successfully without food and money. The ban on fishing and selling of fish make life difficult for a lot of households and worsen an already bad situation as Niger is one of the poorest countries in the world.

The menace of Boko Haram led to the displacement of people and disruption in economic activities. 17 million people in the Lake Chad Basin countries of Nigeria, Chad, Niger and Cameroon are affected by the conflict originating in Nigeria and more than 2.6 million people have been displaced by the conflict. As a result of the insurgency, thousands of people who live in Maiduguri and around the lake fled the violence and became internally displaced persons (IDPs) and refugees in neighbouring countries. The information in Table 1 by Data Tracking Management of International Organization for Migration which was quoted in United Nations Population Fund West and Central Africa Regional Office (UNPFW and CARO, 2017) shows the gravity of the humanitarian crisis in the countries around Lake Chad as a result of the activities of Boko Haram terror group. The lake's disappearance has also brought one gift, the mineral deposit of natron that is left behind as the water evaporates; collecting and trading this mineral provided income for its miners until their trade routes became impassable (Stacke and Hahn, 2017).

Table 1: Indicators of the Humanitarian Situation in the Countries Around Lake Chad

Indicators (2016 & 2017)	Cameroun	Chad	Niger	Nigeria
Internally Displaced Persons (IDPs)	196,538	52,000	225,000	2,151,979
Number of IDPs benefitting from some assistance	15,168	28,750	135,621	41,359
Refugee population by asylum country or territory	342,973	369,540	124,721	1,395
Refugee population by country or territory of origin	10,581	14,940	1,390	167,988

Source: UNPFW and CARO, 2017

IMPLICATION OF POPULATION GROWTH AMONG LAKE CHAD RIPARIAN COUNTRIES

The population of the four countries that share the lake has increased over the years and natural resources have not increased coupled with the fact that there is high level of unemployment and rampant poverty. The countries around Lake Chad are within an area of high demographic growth and in 50 years, the population of these countries has more than quadrupled from 60 million in 1960 to more than 243 million inhabitants in 2017. In 2014, the population living directly from

the resources of Lake Chad was estimated at approximately 2 million people, in an area of nearly 100km around the border tri-point Chad, Cameroon, and Nigeria as shown in Figure 3. The northern basin is home to about 500,000 people, of which the most stable population centres are located at the mouth of the Yobe River while the southern shores of the Lake (southern basin in Nigeria, Cameroon, and Chad) have more than 1.2 million inhabitants and the highest demographic densities.

An increasing population that is not educated or empowered to cater for itself will only lead to an increase in the number of criminals in the society. This is being witnessed in the number of youths who have taken up arms to fight for Boko Haram terror group that has killed several people and carried out arson attacks. A larger percentage of young people in this area have not been productively engaged and that is why they are vulnerable to a group like Boko Haram. Religion has come in the way of birth control as majority of people in this area are Muslims and according to the tenet of their faith, they are allowed to practice polygamy.

Figure 3: Population in Lake Chad regional area
Source: Lemoalle and Magrin, 2014

CONSEQUENCES OF A PERSISTENT FLUCTUATION IN WATER LEVEL OF LAKE CHAD

Loss of species of fishes and vegetative cover

The Lake used to teem with a lot of species of fish that are of economic value. As a result of climate variability and unsustainable water projects, five to eight species of fish have disappeared from different parts of the Lake Chad drainage basin in Nigeria and the experience in the Logone valley, south of the Semry irrigation project is also similar (Obaida et al., 2005). Persistent reduction in the water volume of the lake portends a grave danger as this will impact negatively on the fishers whose livelihood depends on what they are able to get from the lake to cater for their own needs and family members. A swamp belt, the great barrier separates Lake Chad into a north and south pool. Vegetation in the south pool consists of *Cyperus papyrus*, *Phragmites mauritianus*, *Vossia cuspidate* and other wetland plants while *Phragmites australis* and *Typha australis* grow in the more saline north pool. If the water volume continues to go down, these plants will find it difficult to survive.

Loss of valuable wildlife population

Wildlife population that depends on the lake can die off or migrate to other areas in case the lake is not able to support their existence. Sahelian large mammal species that used to be common in the Lake Chad eco-region include red-fronted gazelle, dama gazelle and dorcas gazelle (*Gazella rufifrons, Gazella dama, Gazella dorcas*), patas monkey (*Erythrocebus patas*), striped hyena (*Hyaena hyaena*), cheetah (*Acinonyx jubatus*), caracal (*Felis caracal*), and the endangered wild dog (*Lycaon pictus*). Other species found in the eco-region include the African elephant (*Loxodonta africana*), two species of otter (*Lutra maculicollis, Aonyx capensis*), hippopotamus (*Hippopotamus amphibious*), sitatunga (*Tragelaphus spekei*), and kub (*Kobus kob*). The sitatunga is now considered extinct in Niger, while only a few declining population remains in the Lake Chad region of Nigeria, a reduced hippo population is still present, otters remain common while Nile crocodiles are now uncommon in the lake (Obaida et al., 2005). Also, migratory birds that move at a particular season of the year either to come and breed or do other things might also stop making the annual journey in the event of persistent water reduction of the lake.

Erosion

In the event of the lake going into near extinction, all the trees, shrubs and other forms of vegetative cover that depend on the lake for their survival can dry up naturally. If the land becomes bare as a result of no vegetative cover, wind and water erosion become the order of the day leading to soil and environmental degradation.

Forceful migration

One of the factors blamed for variation in the water level of the lake is reduction in the amount of precipitation. Reduced precipitation and a receding Lake Chad can only worsen an already bad situation. When trees and other forms of vegetative cover have dried up, sand dunes take over and the people, particularly fishers and pastoralists begin to migrate to areas where their existence and those of their animals can be guaranteed. Movement of this kind, particularly the one involving cattle herder has led to serious conflict between them and their host communities.

Resource-induced conflict

If the lake continues to recede, farmers, fishers and pastoralists that depend on it either for water to irrigate their farms, or those who depend on it for fishing activity or the pastoralists that use it as drinking water for their animals (cattle, sheep, goat etc.) will be severely hampered and life will become difficult. One of the coping strategies which some have adopted is to migrate to where they think life will be better for them, their family members and their livestock. This movement of nomads and their animals in particular, to areas with lush pastures is causing a lot of problems particularly in Nigeria where deadly clashes have been reported between herders and farmers. For instance, a lot of lives have been lost in States such as Benue, Adamawa, Taraba and other parts of the country as a result of farmers and herdsmen clashes. In other areas of the country, cases of rape, maiming and arson attacks have also been reported. Over the last 15 years more than 60,000 people have died in this forgotten conflict, almost four times as many as have been killed by the terror group Boko Haram (Hein, 2017).

Reduction in irrigation water supply to crops

Continuous reduction in the water volume of the lake will result in low water supply for irrigational activities. When crops do not get water for a long period of time they begin to die and when crop production is severely hampered in an area, food insecurity may eventually result, and malnutrition will not be far-fetched in such an area.

Loss of livelihood

Livelihood activities such as fishing, farming etc can be lost in the event of the lake not being able to support them again. When people lose their jobs, life can be terrible especially in an environment with few job opportunities and no form of consistent social security. When people are idle, they can resort to crime especially in an environment like north-eastern Nigeria where it has been reported that Boko Haram terrorist group is using money to induce vulnerable individuals to join their terror group.

Increase in crime rate

In an environment where people lose their livelihoods and there are few or no opportunities for them to get another job, there is every tendency or likelihood of them taking to criminal activities such as banditry, cattle rustling etc. There is every possibility that crime rate will increase among the riparian countries of Lake Chad because the population keeps rising and there are few job opportunities coupled with the fact that climate change is taking its toll on traditional livelihood activities such as farming, fishing and animal rearing.

Decline in agricultural activities

Fishing activity might be grounded to a halt and pastoralists that depend on the lake as source of water for their livestock will have no choice but to migrate to other areas with water and pasture for their animals. Farmers and fisher folks who cannot continue with their traditional livelihoods will also have no choice but to migrate to where they can continue with their occupation or embrace other means of livelihoods that will sustain them and their family members.

RESTORING LAKE CHAD AND ITS RESOURCES

Livelihood diversification through technology

One of the quickest approaches that can be adopted in saving Lake Chad is to reduce pressure on its resources through livelihood diversification. It is a known fact that the population of the area is growing rapidly and there is little or no job prospects for people especially the youths in the area apart from

farming, fishing, and animal husbandry. The riparian countries should come together and invest in technology that will propel their people out of the dungeon of poverty. This can only happen by investing in education that works where people will be practically engaged in the production of electronics (radio, television, fan, air conditioners, mobile phones, computers and their accessories, bulbs, refrigerator etc.) most of which are imported from oriental and western countries. The four riparian countries (Nigeria, Niger, Chad and Cameroon) working together as a commission can sign a multilateral agreement with some countries of the world that are well advanced in the production of electronics on technology transfer to local engineers and technicians who will help to train others. This means massive investment in technical education knowing very well that there is a huge market for electronics on the continent as money spent will yield dividend in no distant time. With this kind of initiative, more job opportunities will be created for people in the area thereby reducing the level of unemployment and stop the illegal migration of African youths to Europe who have continued to embark on this dangerous and deadly voyage on regular basis. The riparian country of Niger that has become a stop-over point (particularly Agadez) for migrants towards North Africa and Europe will become a productive hub attracting labour from different countries thereby contributing greatly in reducing the level of joblessness in the West and Central Africa sub-region.

Improved agricultural practices

Maximising limited resources to get better yield is the way to go when it comes to improved agricultural practices. Farmers must be enlightened on improved farming system that will help them to get better yield within the shortest period of time and who are better suited to provide useful information to farmers other than the extension workers? This implies that more agricultural extension workers have to be employed to train farmers through on-site demonstration of research findings that will add value to their agricultural practices. Fishermen who have no other form of livelihood apart from fishing can be persuaded and encouraged to practice aquaculture as a means of reducing overfishing. With proper training and provision of incentives such as fish seeds, fish feed and other vital inputs, the fishermen will be converted into fish farmers that raise fish as against unending fishing activity which reduces fish stocks in the lake.

Creation of protected area and introduction of a moratorium

The success of the livelihood diversification programme should be backed up with the creation of a protected area within and around the lake and should be strengthened with a legal moratorium banning fishing and hunting of certain species of animals for a particular period of time in order to encourage the multiplication and growth of these species of animals which will encourage the ecosystem to rebound and thrive again. This form of conservative measure will ensure sustainability of the lake and its resources. For instance, protection from grazing in the Sidi Toui National Park in south eastern Tunisia produced a dramatic rebound in the natural ecosystem as satellite images from 1987 and 2006 show the revival of grasses and shrub inside the park's boundaries, which appear like puzzle pieces dropped onto the otherwise degraded landscape (UNEP, 2008). When this kind of programme is in place, species of animals that have left can even return and others whose continued existence is threatened by poachers can live safely in their natural habitats. Guards must be employed to enforce this kind of action and they must be given maximum protection by the commission because they will definitely come under attacks from poachers and recalcitrant fishermen.

Birth control measures

The women in Lake Chad area are among the most fertile women in the world going by the number of children per woman in an area where basic amenities are inadequate or virtually non-existent and the level of poverty is relatively high. It is an area where the number of out of school children is also very high and birth control will be pivotal in reducing pressure on the lake and its resources. Rapid population growth in this area will continue to put enormous pressure on a lake that is barely coping to survive from decreased precipitation, withdrawal for human and livestock uses. The Lake Chad Basin Commission (LCBC) should employ birth control experts to persuade both women and men to embrace the use of contraceptives and other birth control measures as a way of reducing pressure on the lake and its resources since natural resources are limited. The LCBC should also try to discourage early

marriage and emphasize education of both boys and girls as a panacea out of poverty and invariably reduce pressure on the lake and its already strained resources.

CONCLUSION

Lake Chad today is not the same as Lake Chad thirty or forty years ago and every good approach must be adopted to ensure that its water volume does not continue to plummet on regular basis. There is no point denying the fact the water level of the lake is fluctuating owing to variation in rainfall which also affects its major supplier, the Chari River. The four riparian countries of Chad, Cameroun, Niger and Nigeria must go beyond regional summit and commit financial resources and deploy every other useful means to save the lake from total collapse through human capital development. People that reside around the lake whose major activity is one form of traditional agricultural practice or the other must embrace improved agricultural practices such as ranching of animals and aquaculture in order to reduce pressure on the lake and its resources.

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